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Abstract

Families in rural or remote areas have limited access to evidence-based intervention for their children with autism. Using web-based training and telemedicine technology, the current study investigated the feasibility of training seven parents to implement Applied Behavior Analysis (ABA) strategies with their children with autism. In this exploratory formative evaluation, parents increased their knowledge of ABA strategies and concepts by an average of 39 percentage points, and improved their implementation of ABA strategies with their children by an average of 41 percentage points. A total of 9,052 driving miles were saved across the four families. Implications for families living in remote areas, improvements in the training program, and future research directions are discussed.

Keywords

autism spectrum disorders, behavior, early, intervention, training, parent, applied behavior analysis

Autism Prevalence and Intervention

Autism first appears in childhood and is a disorder that affects development in socialization, communication, and behavior (American Psychiatric Association, 2000). In 2012, the Centers for Disease Control (CDC) review of 2008 records for 8-year-old children suggested that autism affects 1 in 88 children across all racial, ethnic, and socioeconomic groups (CDC, 2012). With so many children in need of intervention (CDC, 2012; Matson & Kozlowski, 2011), researchers view parent training as an attractive alternative or augmentation to clinician-directed interventions (Brookman-Frazee, Vismara, Drahotka, Stahmer, & Openden, 2012; Steiner, 2011; Steiner, Koegel, Koegel, & Ence, 2012). Many intervention programs for young children involve parents as a way to increase teaching opportunities, generalize outcomes, and reduce treatment costs (Brookman-Frazee et al., 2012; Koegel, Koegel, Fredeen, & Gengoux, 2008). Parent training programs target a range of parental skills and treatment strategies, including the use of functional assessment tools (Brookman-Frazee, Stahmer, Baker-Ericzen, & Tsai, 2006; Powell, Dunlap, & Fox, 2006), behavioral principles (Schultz, Schmidt, & Stichter, 2011), and procedures to increase social communication (Koegel, Symon, & Koegel, 2002; Lang, Machalicek, Rispoli, & Regeher, 2009; Nefdt, Koegel, Singer, & Gerber, 2010; Patterson, Smith, & Mirenda, 2012). Parent–Child Interaction Therapy (PCIT), an example of an empirically

supported treatment for disruptive behavior in young children, is a parent training model that utilizes play therapy and behavioral techniques to improve the relationship between parent and child as parents learn how to be more effective in managing their child's behavior (Eyberg, 1988). This approach has begun to be used with new populations, including children with autism (Eyberg, 2005; Mase, McNeil, Wagner, & Chorney, 2007; Solomon, Ono, Timmer, & Goodlin-Jones, 2008).

While involving parents in training is critical (National Autism Center, 2009; National Research Council, 2001), parent training research remains limited (Crockett, Fleming, Doepke, & Stevens, 2007) and little is known about how to make training resources available to families in remote areas or with limited capacity to travel to facilities for one-on-one hands-on practice and coaching. Several methods and media have been used in an attempt to increase access to training. These methods include video programs (Matson, Mahan, & LoVullo, 2009; Nefdt et al., 2010; Vismara,

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Young, & Rogers, 2012), computerized behavioral parent training programs (Cefai, Smith, & Pushak, 2010; Vismara et al., 2012; Wainer & Ingersoll, 2013), and a week-long intensive training program for families of children with autism in geographically distant areas (Koegel et al., 2002). While these types of programs address the need for adequate dissemination and the importance of parent training, they lack modeling, practice, and feedback, the key components of a quality training (Wyatt-Kaminski, Valle, Filene, & Boyle, 2008). In addition, the limited duration and high response cost of the week-long intensive training program (i.e., parents were required to travel to a regional medical center) limit the ability to effectively reach and train parents in rural/remote areas with limited resources.

Distance Training

Online Instruction

Online instruction has become a popular form of training in private industry and academic settings. Instruction provided on a medium as ubiquitous and accessible as the Internet has advantages compared with other forms of media (e.g., books, videotapes) and workshops, such as reduced travel needs. Decreased travel is particularly important for families of children with a disability because these families are often faced with unique challenges and costs of transporting children and/or finding appropriate child care.

Learners who benefit the most from online training include those who have a specific learning objective and the motivation to learn independently, but lack the time or ability to go to training sessions (Horton, 2000; Vismara et al., 2012; Wainer, & Ingersoll, 2013). Parents who need training in the delivery of effective treatments for their children with autism have all of these characteristics. Applied Behavior Analysis (ABA; Baer, Wolf, & Risley, 1968) therapy is known to be among the most effective treatments for children with autism (National Autism Center, 2009), making it one of the most sought after treatments available. ABA is the scientific study of behavior and its application to socially important problems in the natural environment. ABA is not a specific program, but instead is a method of identifying skills to improve, problem behaviors to decrease, and ways to arrange the environment to support and maintain the changes (Baer et al., 1968). ABA uses empirically validated techniques to improve communication, direction following, eye contact, daily living skills, motor skills, academic skills, as well as decrease problem behaviors such as noncompliance, tantrums, running away, self-injury, self-stimulation, and aggression (Cooper, Heron, & Heward, 2007). It is, however, an intervention that is expensive to sustain in terms of dollars and labor. Thus, parents, particularly those in remote areas where access to ABA therapy is limited, have compelling reasons to learn how to implement ABA therapy with their children. Although a number of

web-based training programs exist for learning ABA (Hamad, Serna, Morrison, & Fleming, 2010), most of them are designed for practitioners who are working toward becoming a licensed ABA provider (e.g. Board Certified Behavior Analyst), and/or they provided limited depth and no opportunities for practice or coaching on skill acquisition.

Telemedicine Training

Families in rural areas are historically subject to a shortage of health care professionals such as medical doctors, specialists, and psychologists (Bransford, Nahabedian, & Waterson, 2010; Charles, 2000; Hojabri, Borousan, & Manafi, 2012; Lockamy & Smith, 2009). With telemedicine technology, individuals in rural communities have better access to the same intervention services available to their urban counterparts (American Telemedicine Association, 2013; Hojabri et al., 2012; Huston & Huston, 2000; Obstfelder, Engeseth, & Wynn, 2007). For example, Vismara, Young, Stahmer, Griffith, and Rogers (2009) compared telemedicine versus face-to-face training to prepare service providers to implement the Early Start Denver model with their families. Their results indicated no difference between the two groups in service providers' fidelity of implementation, satisfaction, or child measures of engagement. Also, Reese and colleagues (Developmental Disabilities Center, 2003) conducted a telemedicine training program for team members charged with monitoring and providing care to individuals with disabilities. They found that for team training, satisfaction between on-site training and telemedicine training was similar. Although there are promising indicators that interventionists can be effectively trained from a distance, we know little about the effectiveness of distance training that prepares parents to implement ABA therapy with their children. Because of the lack of services, particularly in rural areas, and the need for parents to be able to provide and understand effective interventions for their children, there is a strong need for effective distance training programs for parents of children with autism.

The OASIS Training Program

Decades of research suggest that many children with autism can succeed in the regular education classroom if exposed to intensive early intervention even if residual characteristics remain, such as impairment in social behavior. Others will make gains significant enough that they will only require partial or less intensive special education services (Eikeseth, Smith, Jahr, & Eldevik, 2007; Lovaas, 1987; Rogers & Vismara, 2008; Sallows & Graupner, 2005). For intervention to be effective, providers must be well trained (Eldevik et al., 2012; Johnston, Foss, Jacobson, Green, & Mulick, 2006; Randell, Hall, Bizo, & Remington, 2007;

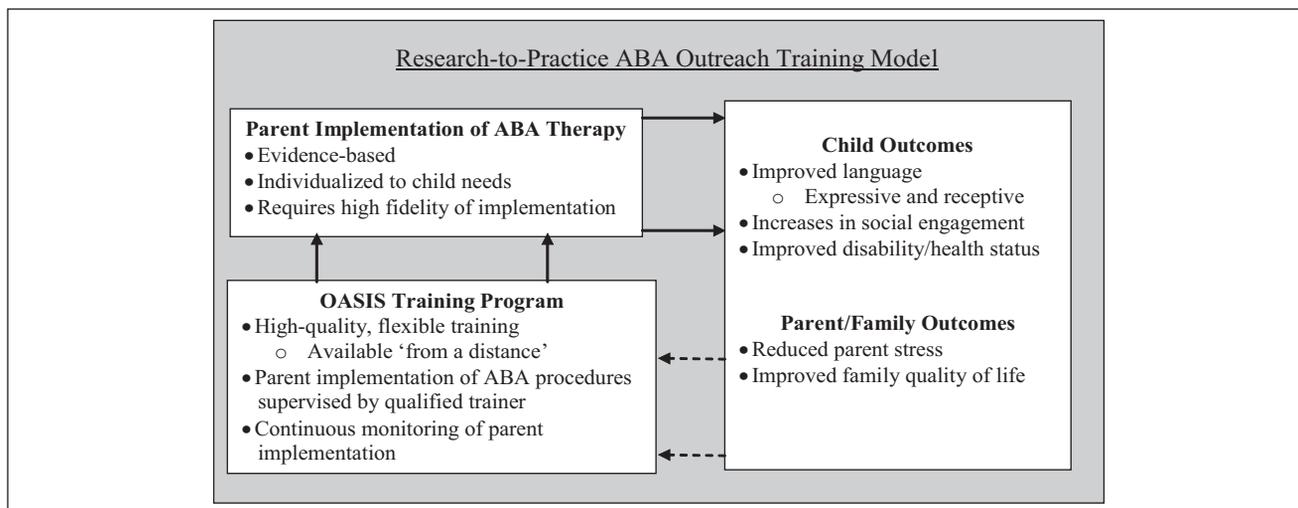


Figure 1. Research-to-practice outreach training model.

Smith & Lovaas, 1998). To show evidence of successful training, it is important to use performance-based measurement, which assesses skill fluency (Eldevik et al., 2012; Gianoumis & Sturmey, 2012; Lafasakis & Sturmey, 2007; Lerman, Tetreault, Hovanetz, Strobel, & Garro, 2008; Sarokoff & Sturmey, 2008; Thomson, Martin, Arnal, Fazio, & Yu, 2009). Educational research suggests that active learner participation and presenting information in small blocks are two key components to effective training programs (Markle, 1990).

Buzhardt and Heitzman-Powell (2005) combined several elements of effective instruction for home-based provider training, specifically, combining experiential training and performance-based measurement as imperative components of training and assessment. In addition to the identification and inclusion of those critical training elements, the previous work of Heitzman-Powell, Buzhardt, Suchowierska, and Morrison (2003) included skills found to be desirable in the delivery of intensive early intervention, specifically the delivery of discrete trial instruction (DTI; Eldevik et al., 2012; Sarakoff & Sturmey, 2008; Thomson et al., 2009), prompting, fading, shaping (Crockett et al., 2007; Fazio, Martin, Arnal, & Yu, 2009; Koegel, Schreibman, & Day, 2008; Petursdottir & Sigurdardottir, 2006), chaining, reinforcement, punishment, data collection, generalization and maintenance (Fazio et al., 2009; Gianoumis & Sturmey, 2012; Ringdahl, Kopelman, & Falcomata, 2009). This training, called the Online and Applied System for Intervention Skills (OASIS) training program (Buzhardt & Heitzman-Powell, 2005; Heitzman-Powell, Buzhardt, Suchowierska, & Morrison, 2003) combines web-based instructional modules with supervised hands-on practice of trained techniques by service providers working directly with children with autism. The current study examined the use of OASIS to train *parents* of children with autism in geographically remote areas.

OASIS Conceptual Model

The OASIS training program uses a *Research-to-Practice Outreach Training* model (Buzhardt & Heitzman-Powell, 2005). As shown in Figure 1, this model, using empirically validated intervention techniques (ABA), functions as a closed loop in that the training program influences implementation of ABA strategies, which influences outcomes, which in turn informs individualization of intervention.

OASIS Development

The purpose of the current study was to formatively evaluate the modified OASIS training program for use with parents from a distance. These modifications included (a) adapting the online tutorials to reflect more parent friendly language and (b) changes in coaching delivery methods (delivered via web-based videoconferencing or “telemedicine”). Table 1 provides a content outline of each of OASIS’s eight training modules (see Table 1). Because of the formative nature (Dick, Carey, & Carey, 2011) of this project, we sought to answer the following questions: (a) How much do parents’ scores on a knowledge assessment of autism and ABA concepts/procedures increase following exposure to the OASIS training program? (b) How much do parents improve their implementation of ABA procedures with their child following exposure to the OASIS training program? and (c) How satisfied are parents with the OASIS training program?

Method

Participants

A total of 10 parents, from six families, were recruited to participate in the training. Two families dropped out after pretesting, but before beginning training because changes

Table 1. OASIS Training Module Content.

Title	Telemedicine session
Module 1	
Introduction to Autism and Behavioral Treatment	Goal: Establish rapport and collect preliminary information on child characteristics <ul style="list-style-type: none"> • Explanation of three domains of autism (communication, behavior, socialization); Review of problem behavior and incidental teaching forms • Parent-child interaction emphasizing describing behavior, imitation, reflection of speech and enthusiasm
Module 2	
Defining and Observing Behavior	Goal: Fine-tune skills taught in Module 1 by reinforcing successful parent observation of their child's behavior and collecting data. <ul style="list-style-type: none"> • Introduction to ABA, operational definitions, review data collection/sheet • Practice/Coaching of parent-child interaction emphasizing behavioral description, dimension, type of data collection
Module 3	
Principles of Behavior	Goal: Understanding of the three-term contingency, reinforcement/punishment, coach parent on use of preference assessment and reinforcer delivery, differential reinforcement, and shaping. <ul style="list-style-type: none"> • Skill Assessment: Preference assessment, reinforcer delivery • Practice/Coaching of parent-child interaction on target skill • Skill Assessment: Short instructions, differential/immediate reinforcement • Practice/Coaching of parent-child interaction on target skill
Module 4	
Stimulus Control	Goal: Understanding of the discriminative stimulus, how to use and fade prompts while maintaining correct response, errorless teaching. <ul style="list-style-type: none"> • Skill Assessment: prompt and prompt fading • Practice/Coaching of parent-child interaction on target skill • Skill Assessment: prompt fading, appropriate instructions and prompts • Practice/Coaching of parent-child interaction on target skill
Module 5	
Effective Teaching Strategies	Goal: Understanding of reinforcer delivery, how to structure the learning environment, task analysis, over-teaching, role-play, and how to conduct sessions to effectively teach their child. <ul style="list-style-type: none"> • Skill Assessment: teaching environment, breaks, attending • Practice/Coaching of parent-child interaction on target skill • Skill Assessment: over-teaching, role-play • Practice/Coaching of parent-child interaction on target skill
Module 6	
Decreasing Behaviors: Antecedent Control	Goal: Understanding of task analysis, generalization, maintenance, behavioral momentum, pre-corrects and general procedures for teaching new skills. <ul style="list-style-type: none"> • Skill Assessment: teaching new skills, generalization and maintenance • Practice Coaching of parent-child interaction on target skill • Skill Assessment: Mass/interspersed trials, following teaching plans • Practice/coaching of parent-child interaction on target skill
Module 7	
Decreasing Behavior: Consequential Control	Goal: Understanding of response cost procedures, over correction procedures, extinction, functional behavioral assessment. <ul style="list-style-type: none"> • Skill Assessment: use of response cost procedures, appropriate responses, extinction, appropriate reinforcement • Practice/coaching of parent child on target skill
Module 8	
Pulling It All Together	Goal: Understanding of the therapy team, components of a team meeting, eight primary curriculum areas and implementation of developed programs. <ul style="list-style-type: none"> • Skill Assessment: discussion of child specific skills to be addressed and development of instructional programs with parent • Skill Assessment: practice implementation of programs written by parents, feedback and adjustments offered • Final comments, questions and wrap-up.

Note. OASIS = Online and Applied System for Intervention Skills.

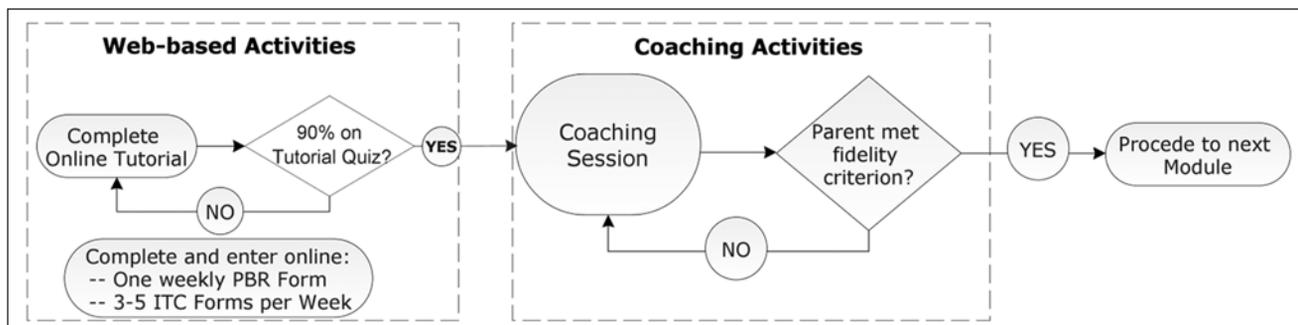


Figure 2. Diagram of procedures to complete an OASIS training module.

in their family commitments and schedules prevented them from being able to commit to a consistent training schedule. Therefore, a total of seven parents from four families participated in this evaluation of the OASIS Training Program. The mean age of the parents was 37.3 (range = 32–47), and their education level ranged from a graduate degree to a high school diploma. Families were recruited through existing service delivery channels (e.g., diagnostic clinics, family practice, infant toddler services, etc.). Parents were compensated for their time upon completion of all project requirements.

Procedures

Each family completed the full OASIS training program including all pre- and posttests. OASIS training involved completion of eight modules, each of which included online activities and participation in distance coaching sessions. As summarized in Table 1, the OASIS modules covered general information about autism, basic ABA principles and procedures, how to use ABA procedures to teach new skills, reduce challenging behavior, generalize skills to other settings, how to collect and analyze data for data-based intervention decision making, and how to work with treatment teams and other providers. Figure 2 provides an overview of the process and activities required to complete an OASIS module, which is described in detail below.

Online activities. Parents completed all online activities through a password-protected online Learning Management System (LMS) that delivered content as needed, recorded their scores on assessments for coaches to review, allowed coaches to track progress, and provided performance feedback to parents. Parents also logged into the LMS to report activities with their children at home (e.g., use of teaching strategies taught in the OASIS program), including antecedents and consequences of specific challenging behavior.

For each module of content in the OASIS program, parents completed an interactive tutorial, followed by a 20-item

knowledge assessment. Because the modules must be completed in a specific sequence (i.e., knowledge from Module 4 builds on knowledge from Modules 1, 2, and 3), module content was not available until prerequisite performance was achieved on prior modules.

Each online tutorial required active responding by trainees in the form of fill-in-the blank, drag and drop, and multiple-choice questions. Immediate feedback in the form of written text was delivered after each response to activities within each tutorial. An important feature of the tutorials was that they required no more than 10 to 20 s to download over weak dial-up Internet connections. This feature was critical to families in geographically remote areas where only 50% of individuals have access to broadband Internet speeds compared with 70% of individuals living in nonrural areas (Smith, 2011). For most users, viewing the online training modules did not require updates to their existing web browser. A 20-question, multiple-choice knowledge assessment followed each tutorial. Mastery criterion was set at 90%, and parents had three attempts to meet this criterion. Access to the next tutorial was contingent on scoring 90% or better on the current tutorial's assessment. These assessments were used to determine progress through the program, not as part of the pre-to-post assessment evaluation of the project.

Live distance coaching sessions. Following completion of a module's online tutorial and knowledge assessment, the family engaged with an OASIS coach via Polycom® videoconferencing. Coaching sessions involved a discussion of the tutorial content and the parents' use of strategies at home, followed by parents practicing the strategies with their child while receiving coaching and feedback from trained coaches. Coaches were located at the regional medical center's telemedicine room, and the family participated through the family's local telemedicine site. Both telemedicine rooms contained adult sized tables and chairs, microphones, and a television monitor. Before beginning the coaching sessions, parents received materials to be used during the sessions, including preschool toys (e.g., cause

and effect toys, ring stackers, cars) and learning materials (e.g., flash cards, dot-to-dot worksheets, crayons and coloring book). They were also provided a small suitcase to transport the items.

Guided by a manualized training protocol, coaches provided instruction and feedback to parents on their use of ABA procedures with their child. Each coach was provided a binder that contained a script for each of the eight modules to guide the telemedicine sessions. Parents received a binder that contained instructions for activities to be completed during the coaching sessions. All treatment sessions followed the same format with a time frame suggested for each designated section of the session. Prior to each session, coaches reviewed parents' scores and responses for the module's tutorial assessment, and reviewed information provided by the parents in the LMS regarding their use of strategies at home and in the community.

Each session began with a discussion of the module's tutorial and the data collected at home on problem behavior and incidental teaching. Next, the coach assessed the parent's fidelity in performing the skill(s) targeted for that part of the module. For example, in Module 3, one such skill was providing contingent reinforcement. To assess this skill, the coach gave the parent a set of activities to perform with their child with the goal of providing several opportunities for the parent to reinforce the child's behavior. During this time, the coach assessed the parent's reinforcement skills by scoring them on 11 components of reinforcement. For this skill, if the parent demonstrated at least 9 of the 11 components (81%), the coach continued to the second coaching session. If the parent demonstrated less than 9 components, then a coaching session was conducted in which the coach provided prompts and feedback as the parent continued to practice the targeted skill. Coaches did not advance parents to the next skill or module until they achieved at least 80% fidelity.

Following the skill assessment, coaches asked parents to play with their child for about 5 min to "make him/her the happiest kid in the world" while the coach observed. Based on elements of Eyeberg's work during the Child Directed Interaction phase of treatment (1988) of PCIT, these brief interludes were designed to establish parents as conditioned reinforcers for their children. These sessions served as a break from the structured activities involved in coaching (in which the interaction was very directive). Feedback was provided following the observation regarding parents' use of descriptive praise and the reduction of questions and demands. During this 5-min play time, parent coaches scored the within-session skill-fluency assessments on each of the targeted skills to ensure parents had reached criterion (80%). Next, for those parents who did not score at least 80% on the skill assessment, an additional coaching session was conducted to teach the skill(s). These data were used for movement through the training only. Additional pre/post

skill-fluency measures were used to determine the overall impact of the training on parents' use of targeted skills (see "Measurement" section below).

Each session ended with a final question-and-answer period, a discussion of what to expect for the next session, and a confirmation of the next appointment day and time. Coaching sessions lasted 90 to 120 min. The total number of sessions for each family ranged from 13 to 19, with an average of 17 across all families. The total number of sessions was dependent on how many sessions parents needed to demonstrate 80% mastery of skills within each module. For those families in which a secondary trainee was involved (e.g., a father), the secondary trainee practiced the skills and received coaching, but only the primary parent was required to reach at least 80% criterion before moving to the next module. All sessions were recorded for later coding of procedural fidelity (see "Procedural Fidelity" section).

Parent-reported use of strategies outside of training. Parents also completed two forms each week regarding their use of the ABA strategies outside of the coaching sessions and entered this information into the online LMS. The first form they were asked to complete was the Problem Behavior Recording (PBR) form. At least twice a week, parents reported the antecedent-behavior-consequence sequence for a specific problem behavior using the PBR. Thus, parents reported what happened just before a challenging behavior (e.g., Sara was asked to put her plate in the sink), described the challenging behavior(s) (e.g., she began rocking back and forth and hitting her fork on the table), and what happened immediately after the behavior (e.g., mom put her dishes in the sink for her). The PBR was designed to increase the active engagement of the parents in identifying the hypothesized function of problem behavior and to provide coaches with a record of how parents managed their child's behavior at home.

The second form parents were asked to complete was the Incidental Teaching Checklist (ITC). Parents completed the ITC daily to report strategies they used to teach their child a new skill or to change, in some way, an existing behavior. In addition to reporting details of the behavior, setting, and strategies used, parents also rated their own ability in using the strategy, how effective it was, and the child's overall behavior for the day. The ITC was designed to increase practice of skills outside the coaching session. Like the PBR, the ITCs were reviewed and discussed during each coaching session.

For three of the four families, both parents requested participation in the training. In these cases, the family identified one parent as the "primary" trainee (designated as "a" on the graphs in the "Results" section; a "b" designation signifies the secondary caregiver). This parent was the "parent of record" in the OASIS online LMS and was designated to

complete the online assessments, including the pre- and posttests. However, the other parent was also encouraged to view the tutorials and enter PBR and ITC information into the LMS. For the coaching sessions, both parents fully participated, completed activities with their child as directed by the coach, and completed the pre- and postskill assessments.

Coach Training

Coaches were trained to criterion on training material and project measures by the project's Lead Coach. The Lead Coach had extensive coach training and was involved in the development of the OASIS training program. Training completion required new Coaches to be 100% reliable for training sessions (procedural fidelity) and at least 80% reliable with the Lead Coach for pre- and posttest scoring. New Coaches then observed the Lead Coach conducting approximately three live coaching sessions. Following these observations, the New Coach conducted at least two sessions with the Lead Coach present. Scoring of coaching statements and content to 90% agreement was required. Finally, the New Coach independently completed a minimum of two sessions, which were then reviewed by the Lead Coach to ensure procedural fidelity continued to be met.

Procedural fidelity. Trained observers independently coded coaches' fidelity of implementation of the coaching procedures from videotaped recordings across a random sampling of 10% of each family's sessions. This sampling percentage was chosen because the coaching procedures were scripted and due to the formative nature of the evaluation (i.e., we were not attempting to demonstrate experimental control). A coaching step was scored as correct if it occurred in the correct order and was implemented as described in the manual. Procedural fidelity was calculated by dividing the number of correctly implemented steps by the total number of incorrectly implemented steps + correctly implemented steps. This ratio was then converted into a percentage. Mean overall fidelity was 98% (range = 75%–100%).

Measurement

Parent skill assessment. The skill assessments were designed to assess parents' use of the ABA strategies taught in the OASIS program. All assessments were conducted immediately (i.e., 1–3 weeks) before and after each family completed the training program. Assessments took place at the regional medical center in which the project staff was housed. The assessment room contained a child-size table, four child-size chairs, materials for the activities (e.g., colored blocks and matching colored bowls, macaroni, beads, string, Play-Doh, etc.), and a video camera for data collection. The assessments involved parent–child interactions

designed to assess parental application of the ABA strategies taught during training. Coaches did not provide feedback to parents regarding their fidelity of implementation. Coders were trained to criterion by coding existing assessments to at least 85% reliability with a master coding rubric.

During the pre- and posttests, parents were asked to engage in six separate activities with their child: (a) preference assessment, (b) structuring the environment, (c) reinforcement procedures, (d) prompts and prompt fading, (e) shaping, and (f) general teaching procedures. This assessment session included brief breaks between activities and a "Free Play" activity to maintain the child's engagement with the activities. Prior to each activity, a coach read the activity instructions to the parent. These activities were videotaped and later coded by research assistants. Across the six skill domains, they coded parents' accuracy in performing 41 discrete skills. Each skill was coded as either an "occurrence" or "nonoccurrence." Nonoccurrence coding included incorrect demonstration of the skill. The research assistant did not provide feedback regarding parents' performance. The total skill assessment session lasted 40 to 60 min.

Two trained observers independently assessed participants' skills via videotape across 40% of pretest and 28% of posttest sessions. An agreement was scored if both observers tallied the occurrence or nonoccurrence of the skill. A disagreement was scored if a tally for a given skill differed. For each session, the number of skills scored in agreement was divided by the total number of agreements + disagreements and converted into a percentage. Mean agreement for the pretest was 89% (range = 83%–93%) and 85% for the posttest (range = 73%–94%).

Parent knowledge assessment. Online assessments of parents' knowledge of OASIS content were used to assess increases in parents' knowledge of autism and ABA principles and procedures used to teach children new skills and reduce challenging behavior. All knowledge assessment items were provided in multiple-choice format. One to two weeks prior to beginning the training program, parents completed a global online pretest that covered the entire OASIS curriculum. This assessment contained 48 multiple-choice items, with six items from each of the eight online tutorial assessments. Items were presented in a random order on all assessments. The posttest was identical to the pretest and was completed at least 1 to 2 weeks following the completion of training and was designed to assess the overall impact of the online training on parents' knowledge.

Parent satisfaction with training. A researcher-developed consumer satisfaction survey was administered to families postintervention and during follow-up assessments to determine the social validity of the OASIS training program (Schwartz & Baer, 1991). Each parent rated each module in terms of

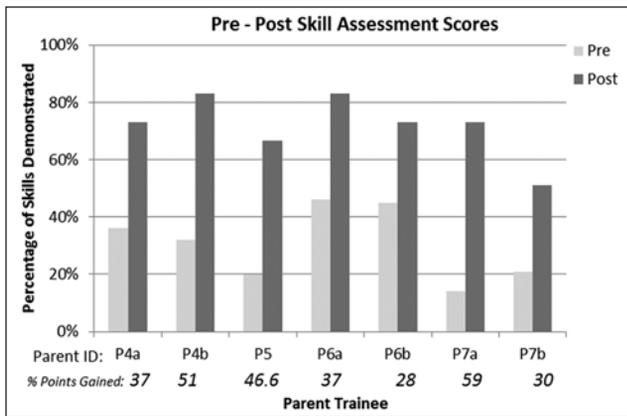


Figure 3. Parents' pre- to posttest skill gains.

importance and parents' overall satisfaction with the online content and coaching sessions.

Cost savings. We compared the number of miles families lived from the regional medical center where the researchers provided the parent coaching sessions with the number of miles they lived from their local telemedicine site. This provided an indicator of the time and money (based on the Internal Revenue Service rate of reimbursement for the year 2009) saved by accessing the coaching from their local telemedicine site relative to driving to the medical center for face-to-face coaching.

Results

How Much Do Parents' Scores on a Knowledge Assessment of Autism and ABA Concepts/Procedures Increase Following Exposure to the OASIS Training Program?

On the 48-item global pre- and posttests over OASIS content, parents designated as the primary participant scored a mean of 53.13% correct on the pretest and 92.25% correct on the posttest. The knowledge gains from pre- to posttest ranged from 90 to 12.5 percentage points with a mean gain of 39.13. Gains did not appear to be related to pretest scores (i.e., higher pretest did not appear to lead to higher posttest scores).

Do Parents Improve Their Implementation of ABA Procedures With Their Child Following Exposure to the OASIS Training Program?

Figure 3 shows parents' pre- and posttraining performance on the ABA skill assessments. Across all parents, the mean pretest performance was 30.6% (range = 14%–46%), and the mean posttest performance was 71.8% (range = 51%–83%).

The mean pre- to posttest skill gain across all parents was 41.23 percentage points (range = 28%–59%).

Figure 4 shows the pre- to posttest scores for each parent within each domain. Parents demonstrated the highest pretest performance on the Structuring the Environment assessment and the lowest performance on the Shaping New Skills assessment. Parents achieved the highest mean posttest performance on the Preference Assessment domain (87.8%), and the lowest on Shaping (53.6%). The largest pre- to posttest gain score was on Preference Assessment (61.2 percentage points), and the lowest mean gain was on Structuring the Environment domain (16.3 percentage points).

How Satisfied Were Parents With the OASIS Training Program and How Many Travel Miles Did They Save by Using Telemedicine for the Coaching Sessions?

Results of parents' posttraining satisfaction ratings are shown in Figure 5. Families rated the importance of the content and their satisfaction with the online content and telemedicine coaching sessions on a scale of 1 to 5 with 5 being the most important/satisfied. The online tutorials had a mean importance rating of 4.62 (range = 4.38–4.88), and a mean satisfaction rating of 4.71 (range = 4.17–4.94). The telemedicine coaching sessions had a mean importance rating of 4.64 (range = 4.75–4.46) and a mean satisfaction rating of 4.8 (range = 4.67–4.94).

To determine the number of travel miles saved by using telemedicine for the coaching sessions instead of face-to-face office or home visits, we compared the number of miles families *would have* traveled to the regional medical center to the number of miles they *actually* traveled to their local telemedicine site. Table 2 shows these miles for each of the four participant families. Families completed an average of 17 sessions (range of 13–19). This range occurred because of the variation in the number of sessions families needed to achieve at least 80% mastery of each module's content. The mean distance families would have traveled without telemedicine was 150 miles (i.e., from their home to the regional medical center for face-to-face training), compared with the actual mean distance of 18.45 to the telemedicine sites. Had the families attended sessions at the regional medical center for face-to-face coaching, the total number of miles driven would have ranged from 1817 to 3834. Conversely, the actual round-trip miles families traveled to their local telemedicine site ranged from 1.2 to 49. Given the number of sessions each family needed to complete the training, ranging, the total number of travel miles families saved by participating in the coaching sessions via telemedicine was 9,052 for these four families, with a mean travel savings per family of 2,263 miles.

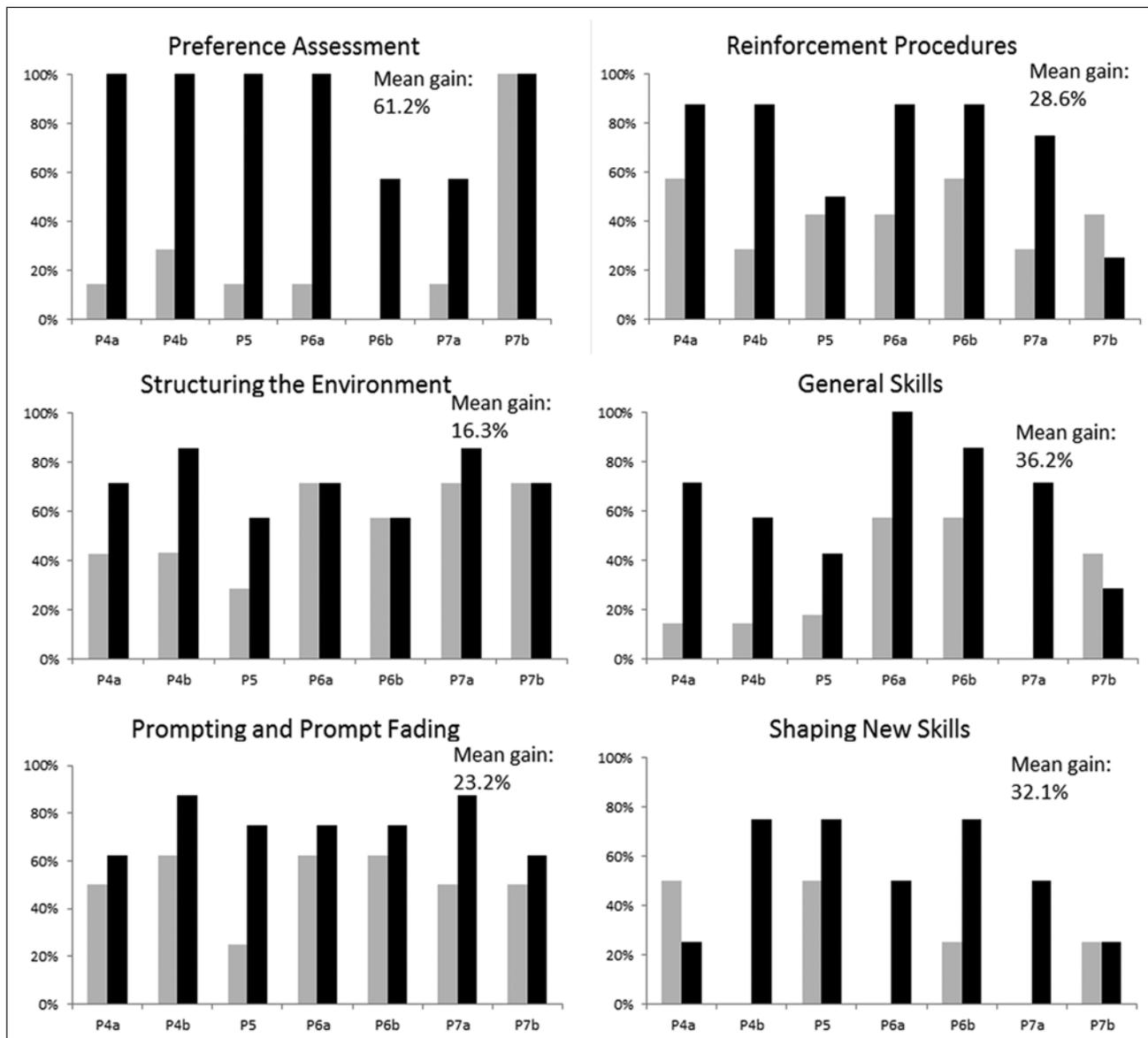


Figure 4. Parents' pre- postskill gains for each of the six OASIS domains.

Discussion

The purpose of this study was to formatively evaluate the feasibility of the OASIS parent training program implemented from a distance for parents of young children with autism. Key to this evaluation was determining its feasibility with a diverse group of families to inform training revisions and improvements. Therefore, despite the small sample, there was a wide range in parents' educational backgrounds (high school diploma to graduate degree) and family incomes (\$30k-\$75k+). In addition, because of the growing prevalence of autism diagnoses it was important to assess the feasibility of teaching ABA intervention techniques using distance technology rather than simply comparing it with

face-to-face training. Others have demonstrated comparable satisfaction (Developmental Disabilities Center, 2003) and learning gains (Vismara et al., 2009) between distance and face-to-face training and service delivery. Therefore, because of the need for effective distance ABA parent training, we assessed the feasibility of providing distance OASIS training rather than expending resources on a comparison of distance with face-to-face training.

Using OASIS, parents were trained to criterion, from a distance, on targeted evidence-based strategies implemented with their young children with autism. Parents completed the online activities from home and participated in the videoconferencing skill training sessions at a local school, community center, or hospital. This has implications for families and their children

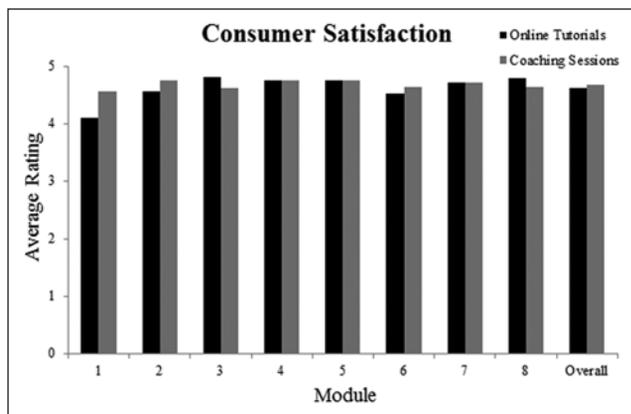


Figure 5. Parents' satisfaction with content and skill.

with autism in rural areas, considering that (a) 15% to 20% of the U.S. population lives in rural/remote areas (U.S. Census Bureau, 2000, 2005–2007), (b) autism is equally prevalent in these areas, and (c) access to evidence-based interventions for families in rural/remote areas is extremely limited (Charles, 2000; Huston & Huston, 2000; Perednia & Allen, 1995). The results of this study will be used to inform improvements in specific content areas (e.g., Shaping New Skills), to explore the use of more cost-effective home-based web conferencing tools (e.g., Skype™ or FaceTime™), to investigate ways to engage additional caregivers in the training and to inform more rigorous empirical investigations of OASIS's effect on parent skills and child outcomes. Overall, this evaluation suggests that OASIS has promise to be a feasible and effective training program for increasing parental skill in the implementation of ABA strategies with their young children with autism. Outcomes, however, should not be interpreted as conclusive given the small sample size and exploratory methodologies used.

Knowledge Gains

Parents' overall knowledge gains from pre- to posttest were promising, particularly considering that posttest performance did not appear to be influenced by parents' prior knowledge of ABA (i.e., pretest performance). Knowledge gains also appeared to be independent of parents' educational background given that P5, with the least formal education, made the *highest* pre- to posttest gain (90 percentage points), and P6a, with a graduate degree, had the *second lowest* gain (23 percentage points). Parents' scores on the tutorial posttests were similar to results reported in a prior study of this web-based training component with paraprofessionals (Buzhardt & Heitzman-Powell, 2005). Similar to the paraprofessionals in that study, parents performed best on the first tutorial in which general information about autism and common treatment procedures are introduced. Parents' lowest performance occurred on the third tutorial,

which introduced the principles of reinforcement, punishment, and the Three-Term Contingency (ABC: Antecedents, Behaviors, and Consequences).

Skill Gains

All parents demonstrated substantial gains in implementation of ABA skills from pre- to post-training (Figure 4; range = 28–59 percentage point gains). Given the small sample size, correlation analyses would not have been appropriate to explore relationships between trainee demographics and skill gains. However, comparisons between demographics and skill gains suggest that these gains were not influenced by education background, family income, or the number of children in the home. We considered the number of children in the home because there is evidence to suggest that family size, like education background and income, influences child and parent outcomes, particularly maternal work and stress (Black, Devereux, & Salvanes, 2004; Frenette, 2011). There was substantial variation in parents' performance across skill domains. To identify the possible causes of this variation, particularly the domains with low performance, it is important to consider both the coaching content and the assessment (Dick et al., 2011). The skill in which parents performed the worst at pretest and made the most significant gains was the "Preference Assessment." Because effective reinforcement of desired behavior is a key component of ABA (Pace, Ivancic, Edwards, Iwata, & Page, 1985), a parent's ability to identify effective reinforcers is critical (Cooper et al., 2007). Although the least amount of gains were achieved in the "Structuring the Environment" domain, this is partly attributed to parents' high pretest performance in this area. This domain targeted parents' skill in arranging the learning environment in preparation for teaching a new skill (e.g., placing reinforcers and extra teaching materials out of the child's reach, and prompting and reinforcing the child's attending to the activity). Of particular concern for "Structuring the Environment" is the fact that only two out of seven parents scored over 80% at posttest despite the fact that parents achieved the second highest average pretest performance in this domain. Within this domain, parents performed lowest on prompting and reinforcing attending, suggesting that a stronger emphasis is needed on these two skills during coaching or perhaps a higher mastery criterion for this domain. Another domain of concern was "Shaping New Skills," which had the lowest pretest scores (21.4%) and also the lowest posttest scores (53.6%), suggesting that parents came in with little knowledge and left without mastery (no parents achieved 80% mastery at posttest).

In addition to the gains made by primary parents (mean of 44.9 percentage points), secondary parents who were not required to complete the tutorials and assessments, but

Table 2. Mileage Savings for Participating Families.

Trainee family	Number of sessions	Without telemedicine		With telemedicine		Miles saved with telemedicine
		Round trip	Total distance	Round trip	Total distance	
P4	18	78.4	1,411.2	49	882	529.2
P5	18	213	3,834	2	36	3,798
P6	13	139.8	1,817.4	21.6	280.8	1,536.6
P7	19	169	3,211	1.2	22.8	3,188.2
Totals			10,273.6		1,221.6	9,052
Averages	17	150.05	2,568.4	18.45	305.4	2,263

often reported completing the tutorials after their spouse, also showed improvements in ABA implementation with their child (36.3 percentage point gain). The gains of the secondary trainees, all fathers, are promising considering that (a) they were not the primary contact for communications between coach and parent between coaching sessions, (b) they were not required to attend all coaching sessions (although they each attended at least 90% of the coaching sessions), (c) they were not required to achieve 80% mastery of skills during coaching sessions, and (d) they were not required to complete the online tutorials although they reported viewing most of them with their spouse or on their own. Evidence suggests having a father figure more involved with parenting and therapy leads to better child outcomes (Bronte-Tinkew, Carrano, Horowitz, & Kimukawa, 2008; Lewis & Lamb, 2003; MacDonald & Hastings, 2010) and reduced maternal stress (Keller & Honig, 2010; Simmerman, Blacher, & Baker, 2001). Therefore, this formative evaluation of the OASIS training program suggests further research is needed to investigate ways to accommodate another caregiver into the training.

A limitation of both the skill and knowledge assessments is that parents did not complete pretests prior to each module. Pretests prior to each module would have provided a clearer indication of what parents knew and could do immediately prior to that module's training. However, pretesting also requires a substantial amount of time for parents. This further extends training time and requires parents to attempt tasks with which they are unfamiliar, potentially resulting in lower satisfaction and increased attrition.

Satisfaction and Miles Saved

Overall satisfaction with the training tutorials and coaching sessions was high. Parent ratings of importance and satisfaction were relatively stable across all tutorials and coaching sessions, ranging from 4.17 to 4.94. This is significant particularly considering the time commitment required of families: 90–120 min coaching sessions and approximately 60 min of computer time each week, plus the time required to travel with their child to the local telemedicine site. Furthermore, parents were required to participate in the

pre- and posttest skill assessments, which are clearly needed to assess the effectiveness of the training, but have little value to the families. The difficulty of the content did not appear to have a negative influence on these ratings considering that parents performed lowest on Module 3 content, yet gave it one of the highest ratings (see Figure 5). Conversely, Module 1 received some of the lowest ratings despite the fact that parents had their highest performance on this module's tutorial.

A potential factor in satisfaction and feasibility is the distance parents had to travel to receive coaching. Therefore, we compared the difference between the distances families *actually* traveled to the local telemedicine site to the distance they *would* have traveled to access face-to-face services. The 9,052 miles saved across these families was substantial considering continuously rising fuel prices and the time required traveling those distances. No clear pattern emerged regarding the influence of distance to the training site on trainee satisfaction.

Limitations and Future Directions

By targeting primary caregivers, this training program has the potential for targeted skills to be consistently integrated into their daily parenting practices. The primary limitations of this evaluation include the small sample size, a lack of comparison data, and lack of child outcome data. A larger comparison study (e.g., randomized trial or wait-list control study) is needed to investigate the effects of training relative to a control or 'wait' condition (Shadish & Cook, 2009; Shadish, Cook, & Campbell, 2001). Thus, a larger study is needed to determine what factors influence parents' consistent use of trained techniques with their children and the subsequent impact on child outcomes over time.

OASIS was designed to be implemented with a maximum of two caregivers per family. However, considering the often large and varying caregivers involved in a child's life, consideration of adapting the protocol for larger groups is warranted. Additional research is needed to determine whether teaching multiple caregivers has a greater impact than if only one or two caregivers received training. This may also involve the development of modules that teach

caregivers how to train others (e.g., relatives, siblings, teachers), to use ABA principles during every day activities. Other training questions remain, such as determining how increasing the number of trainees impacts the training program's costs and effectiveness, what is the maximum number of trainees that a single coach can effectively train, the relationship between the number of caregivers trained for a single child, and the generalizability of the training on child outcomes.

Additional research is also needed to investigate other factors that contribute to the effectiveness and feasibility of the training. For example, are the effects of the training moderated by coach characteristics (e.g., ABA background, experience in working with families, enthusiasm, etc.), family or child characteristics (e.g., child's placement on the autism spectrum, family education background, socioeconomic, or access to resources), or parents' experience with technology? In addition, are there specific modules or components that could be removed or scaled down without significantly affecting caregiver learning?

While some researchers are beginning to address the different types of treatment fidelity/integrity (Hagermoser Sanetti & Kratochwill, 2009), the differing levels of reliability and fidelity for both the implementation and research pose a potential liability for replication. For implementation there were two levels (see "Methods" sections for more details): (a) 90% accuracy for answers on the online tutorial posttest and (b) 80% accuracy required for within-session parent skill (to move to the next section). For the research, there were four levels related to training new coaches: (a) 80% scoring reliability on pre- posttest project measures, (b) 85% reliability when scoring parent performance on within-session assessments, (c) 90% fidelity for delivering in-session coaching statements related to the specific module topic, and (d) 100% fidelity on following the scripted manual. For this development project, we used an 80% interrater reliability criterion for pre- posttest measures. However, for those elements related to training implementation, we set a higher standard for both participants (90% accuracy on the tutorial posttests) and for coach training and implementation (90%–100%), particularly given the scripted nature of the intervention. These differing levels of reliability and fidelity may have contributed to the one low reliability score (75%) on the procedural fidelity for new coach training (100% required implementation fidelity). In addition, the one low reliability score for parental skill (73%) was with the first participant of the formative evaluation. Following these low scores, definitions were revised and the assessment was rescored. Following this correction, all remaining reliabilities ranged between 83% and 93.5%, within the criterion set for the research (80%). Finally, the number of fidelity checks required for implementation fidelity was low (10% sample of all coaching sessions). Given the scripted nature of the intervention (each coach

was required to follow the same sequence, mark the section as completed, and score coaching statements within the session protocol), we determined that a 10% sampling of sessions was sufficient. Because all sessions were recorded, had it been determined that if coaches were not implementing the sessions with fidelity, a more stringent and frequent fidelity check would have been adopted. The use of lower fidelity checks may be acceptable for "practices that are systematically designed with built-in scripting, review opportunities" (Harn, Parisi, & Stoolmiller, 2013, p. 187). Future research should address each of these issues to determine whether the training could be delivered in a shorter time frame, decreasing the overall response effort of the families while maintaining the caregiver learning, and normalizing reliability/fidelity across implementation and coach training.

Several factors presented challenges to the success of the program. First and foremost was limited access to adequate telemedicine technology, particularly in rural areas. Several participants lived in small communities, with limited resources for the equipment necessary for the telemedicine sessions. When contacting potential sites for use of the equipment, some sites were unaware of the existence of the technology anywhere in the surrounding area. Some facilities required user fees, including staffing fees for technology support services. Reliance on staff at remote sites presented concerns as well, including hours available for use and accommodating the needs of the participants. Additional challenges included technical difficulties with the PolyCom equipment, environmental arrangement of rooms for families, and disrupted communication due to child activities and vocalizations. From a clinical standpoint, the exclusive reliance on verbal communication rather than physical prompting or modeling was also a distinctive change in teaching techniques.

Since the initial design and development of the OASIS training program, other distance communication technologies have rapidly emerged with promise for improving the delivery of distance training and coaching in natural settings. For example, one limitation of the current iteration of the training program is a lack of engagement with trainees directly in their homes and/or community settings. The use of common mobile technologies could allow in-the-moment coaching recommendations for caregivers at times when they need it most at home or in other settings outside of the coaching sessions. The use of cell phones to support home-based intervention and home visiting models have been explored in a limited number of training projects (Bigelow, Burke-Lefever, Carta, & Borkowski, 2010; Bigelow, Carta, & Lefever, 2008; Gomez, 2008; Jabaley, Lutzker, Whitaker, & Self-Brown, 2011; Jones, Forehand, McKee, Cuellar, & Kincaid, 2010; Wang, Wang, & Kim, 2011), but more research is needed to determine how they could be used to support

caregiver-delivered, evidence-based practices. Finally, with continued improvements in access to broadband Internet access required for effective live videoconferencing, there is a clear need to explore the effectiveness of the OASIS coaching model when delivered via commonly available videoconferencing tools such as Skype© and Oovoo©. This would eliminate the need for caregivers to drive to a location that provided access to a Polycom system and could further improve its generalizability because coaching would be provided directly in the home.

Conclusion

The development of this distance ABA training program has the potential to address two primary problems for parents of children with autism: (a) the lack of available ABA therapists in remote/rural areas to support the growing demand for their services and (b) the role of primary caregivers with limited or no ABA experience as a critical component to the success of early intervention. Training parents and primary caregivers to implement ABA with their children reduces the need for outside therapists and allows parents to implement ABA with young children before they begin preschool or kindergarten. Although empirical studies of its effectiveness are needed, the OASIS training program holds promise as a means to build capacity for ABA therapy in areas where it never before existed: rural/remote populations with parents who are the best suited to serve as primary interventionists for their children.

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